

What is claimed is:

1. A clamping apparatus, wherein

a plug portion (27) is projected from a reference member
5 (2) so as to be inserted into a hole (5) opened in a movable
member (3),

a fitting surface (16) allowed to fit to an inner
peripheral surface of the hole (5) is formed on an outer
peripheral surface of the plug portion (27), a fluid flow hole
10 (38) is opened in the fitting surface (16), and when the fitting
surface (16) comes into close contact with the inner peripheral
surface of the hole (5), the fluid flow hole (38) is closed by
the inner peripheral surface of the hole (5).

15 2. A clamping apparatus as set forth in claim 1, wherein
pressurized fluid is jetted from the fluid flow hole (38).

3. A clamping apparatus as set forth in claim 2, wherein
the pressurized fluid is used also as pressurized fluid for
20 cleaning.

4. A clamping apparatus as set forth in claim 2, wherein
the pressurized fluid is compressed air.

25 5. A clamping apparatus as set forth in claim 1, wherein
fluid is sucked into the fluid flow hole (38).

6. A clamping apparatus as set forth in claim 1, wherein the fluid flow holes (38) are provided in plurality.

5 7. A clamping apparatus as set forth in claim 6, wherein the fluid flow holes (38) are provided circumferentially in plurality.

8. A clamping apparatus as set forth in claim 7, wherein
10 a housing (9) provided in the reference member (2) is provided with a fluid port (39) for supplying pressurized fluid or discharging fluid, and
the fluid port (39) is branched via a passage (42) from the fluid port (39) and is communicatively connected to each of the
15 plurality of fluid flow holes (38).

9. A clamping apparatus, wherein
a central pillar (12) is projected from a reference member (2) so as to be inserted into a hole (5) opened in a movable
20 member (3),

the central pillar (12) is provided with an inclined outer surface (13) that gets closer to the axis toward a leading end of the projecting direction,

an annular intermediate member (15) in which at least a
25 part of the circumferential direction is allowed to deform in both the expanding direction and contracting direction is

arranged at the outside of the inclined outer surface (13), the intermediate member (15) is provided with a straight outer surface (16) allowed to fit to an inner peripheral surface of the hole (5) and with an inclined inner surface (17) facing the
5 inclined outer surface (13),

a pull member (21) is inserted into the central pillar (12) axially movably, and the pull member (21) is connected to the intermediate member (15),

a lock means and a release means are provided in the
10 reference member (2), the lock means moves the intermediate member (15) via the pull member (21) toward a base end for locking and the release means moves the intermediate member (15) via the pull member (21) toward the leading end for releasing,

a fluid flow hole (38) is opened in the straight outer
15 surface (16) of the intermediate member (15), and when the intermediate member (15) moves for locking and the straight outer surface (16) comes into close contact with the inner peripheral surface of the hole (5), the fluid flow hole (38) is closed by the inner peripheral surface of the hole (5).

20

10. A clamping apparatus as set forth in claim 9, wherein

a housing (9) provided in the reference member (2) is provided with a fluid port (39) for supplying pressurized fluid or discharging fluid,

25 a fluid passage (40) is provided inside the housing (9) and the fluid passage (40) is connected to the fluid port (39),

the fluid passage (40) is provided with a relay opening (41) in the inclined outer surface (13) of the central pillar (12), and

the fluid flow hole (38) is provided so that one end is
5 opened in the straight outer surface (16) and the other end is opened in the inclined inner surface (17) respectively, and the other end faces the relay opening (41).

11. A clamping apparatus as set forth in claim 10, wherein
10 the fluid flow holes (38) are provided in plurality.

12. A clamping apparatus as set forth in claim 11, wherein
the fluid flow holes (38) are provided circumferentially in
plurality.

15

13. A clamping apparatus as set forth in claim 12, wherein
the fluid passage (40) is communicatively connected to a
groove (42) formed in the circumferential direction in at least
either the inclined outer surface (13) of the central pillar
20 (12) or the inclined inner surface (17) of the intermediate
member (15), and

each of the openings of the fluid flow holes (38) on the
inclined inner surface (17) side faces the groove (42).

25 14. A clamping apparatus as set forth in claim 12, wherein
the pull member (21) is allowed to pull the movable member

(3) toward the reference member (2) side.

15. A clamping apparatus, wherein

a central pillar (12) is projected from a reference member
5 (2) so as to be inserted into a hole (5) opened in a movable member (3),

the central pillar (12) is provided with an inclined outer surface (13) that gets closer to the axis toward a leading end of the projection direction,

10 a plurality of pressing members (43) that are radially movable are arranged at the outside of the inclined outer surface (13), and the pressing member (43) is provided with a straight outer surface (16) allowed to fit to an inner peripheral surface of the hole (5) and with an inclined inner
15 surface (17) facing the inclined outer surface (13),

a pull member (21) is inserted into the central pillar (12) axially movably, and the pull member (21) is connected to the pressing members (43),

a lock means and a release means are provided in the
20 reference member (2), the lock means moves the pressing members (43) via the pull member (21) toward a base end for locking, and the release means moves the pressing members (43) via the pull member (21) toward the leading end for releasing,

a fluid flow hole (38) is opened in the straight outer
25 surface (16) of the pressing member (43), and when the pressing member (43) moves for locking and the straight outer surface

(16) comes into close contact with the inner peripheral surface of the hole (5), the fluid flow hole (38) is closed by the inner peripheral surface of the hole (5).

5 16. A clamping apparatus as set forth in claim 15, wherein
a housing (9) provided in the reference member (2) is
provided with a fluid port (39) for supplying pressurized fluid
or discharging fluid,

a fluid passage (40) is provided inside the housing (9),
10 and the fluid passage (40) is connected to the fluid port (39),
the fluid passage (40) is provided with a relay opening
(41) in the inclined outer surface (13) of the central pillar
(12), and

the fluid flow hole (38) is provided so that one end is
15 opened in the straight outer surface (16) and the other end is
opened in the inclined inner surface (17) respectively, and the
other end faces the relay opening (41).

17. A clamping apparatus as set forth in claim 16, wherein
20 the fluid flow holes (38) are provided in plurality.

18. A clamping apparatus as set forth in claim 17, wherein
the fluid flow holes (38) are provided circumferentially in
plurality.

25

19. A clamping apparatus as set forth in claim 14, wherein

the pull member (21) is allowed to pull the movable member (3) toward the reference member (2) side.

20. A clamping apparatus, wherein

5 a central pillar (12) is projected from a reference member (2) so as to be inserted into a hole (5) opened in a movable member (3),

an inner sleeve (61) which is radially expandable and contractible is supported on the central pillar (12) movably
10 along the axis of the central pillar (12), and a tapered outer surface (13) is formed on an outer peripheral surface of the inner sleeve (61),

an outer sleeve (71) which is radially expandable and contractible is arranged at the outside of the inner sleeve (61),
15 a tapered inner surface (17) allowed to make a tapering engagement with the tapered outer surface (13) is formed on an inner peripheral surface of the outer sleeve (71), a straight surface (16) allowed to fit to an inner peripheral surface of the hole (5) is formed on an outer peripheral surface of the
20 outer sleeve (71),

an advancing means (25) which presses the inner sleeve (61) in such a direction as to tighten the tapering engagement is provided,

a fluid flow hole (38) is opened in the straight outer
25 surface (16), and when the straight outer surface (16) comes into close contact with the inner peripheral surface of the hole

(5), the fluid flow hole (38) is closed by the inner peripheral surface of the hole (5).

21. A clamping apparatus as set forth in claim 20, wherein

5 a housing (9) provided in the reference member (2) is provided with a fluid port (39) for supplying pressurized fluid or discharging fluid,

a fluid passage (40) is provided inside the housing (9), and the fluid passage (40) is connected to the fluid port (39),

10 the fluid passage (40) is provided with a relay opening (41) in an outer peripheral surface of the central pillar (12), and

the fluid flow hole (38) is provided so that one end is opened in the straight outer surface (16) and the other end is
15 opened in the tapered inner surface (17) respectively, and the other end is connected to the relay opening (41) via a communication hole (79) formed in the inner sleeve (61) in a penetrating manner.

20 22. A clamping apparatus as set forth in claim 21, wherein the fluid flow holes (38) are provided in plurality.

23. A clamping apparatus as set forth in claim 22, wherein

the fluid flow holes (38) are provided circumferentially in
25 plurality.

24. A clamping apparatus as set forth in claim 23, wherein

the fluid passage (40) is communicatively connected to a groove formed in the circumferential direction in at least either the inclined outer surface (13) of the inner sleeve (61) or the inclined inner surface (17) of the outer sleeve (71), and each of the openings of the fluid flow holes (38) on the inclined inner surface (17) side faces the groove.

25. A clamping apparatus as set forth in claim 20, wherein

a pull member (21) is provided on the housing (9) provided in the reference member (2), and

the pull member (21) is allowed to pull the movable member (3) toward the reference member (2) side.

26. A clamping apparatus, wherein

a central pillar (12) is projected from a reference member (2) so as to be inserted into a hole (5) opened in a movable member (3),

an intermediate member (15) which is radially expandable and contractible is supported on the central pillar (12) movably along the axis of the central pillar (12),

a tapered fitting surface (16) is formed on an outer peripheral surface of the intermediate member (15), a tapered inner surface (17) allowed to make a tapering engagement with the tapered fitting surface (16) is formed on the hole (5),

an advancing means (25) which presses the intermediate

member (15) in such a direction as to tighten the tapering engagement is provided, and

a fluid flow hole (38) is opened in the tapered fitting surface (16), and when the tapered fitting surface (16) comes
5 into close contact with the tapered inner surface (17), the fluid flow hole (38) is closed by the tapered inner surface (17).

27. A clamping apparatus as set forth in claim 26, wherein

a housing (9) provided in the reference member (2) is
10 provided with a fluid port (39) for supplying pressurized fluid or discharging fluid,

a fluid passage (40) is provided inside the housing (9), and the fluid passage (40) is connected to the fluid port (39),

the fluid passage (40) is provided with a relay opening
15 (41) in an outer peripheral surface of the central pillar (12),

the fluid flow hole (38) is provided so that one end is opened in the tapered fitting surface (16) and the other end is opened in an inner peripheral surface of the intermediate member (15) respectively, and the other end faces the relay opening
20 (41).

28. A clamping apparatus as set forth in claim 27, wherein the fluid flow holes (38) are provided in plurality.

25 29. A clamping apparatus as set forth in claim 28, wherein the fluid flow holes (38) are provided circumferentially in

plurality.

30. A clamping apparatus as set forth in claim 29, wherein

the fluid passage (40) is communicatively connected to a
5 groove formed in the circumferential direction in at least
either the inner peripheral surface of the intermediate member
(15) or the outer peripheral surface of the central pillar (12),
and

each of the openings of the fluid flow hole (38) on the
10 inner peripheral surface side of the intermediate member (15)
faces the groove.

31. A clamping apparatus as set forth in claim 26, wherein

a pull member (21) is provided on the housing (9) provided
15 in the reference member (2), and

the pull member (21) is allowed to pull the movable member
(3) toward the reference member (2) side.

32. A clamping apparatus, wherein

20 a central pillar (12) is projected from a reference member
(2) so as to be inserted into a hole (5) opened in a movable
member (3),

an intermediate member (15) which is radially expandable
and contractible is supported on a support hole (92) of the
25 movable member (3) movably along the axis of the support hole
(92),

a tapered inner surface (17) constituting the hole (5) is formed on an inner peripheral surface of the intermediate member (15), and a tapered fitting surface (16) allowed to make a tapering engagement with the tapered inner surface (17) is
5 formed on the central pillar (12),

an advancing means (25) which presses the intermediate member (15) in such a direction as to tighten the tapering engagement is provided, and

a fluid flow hole (38) is opened in the tapered fitting
10 surface (16), and when the tapered fitting surface (16) comes into close contact with the tapered inner surface (17), the fluid flow hole (38) is closed by the tapered inner surface (17).

33. A clamping apparatus as set forth in claim 32, wherein
15 the fluid flow holes (38) are provided in plurality.

34. A clamping apparatus as set forth in claim 33, wherein
the fluid flow holes (38) are provided circumferentially in plurality.

20

35. A clamping apparatus as set forth in claim 32, wherein
a pull member (21) is provided on the housing (9) provided in the reference member (2), and

the pull member (21) is allowed to pull the movable member
25 (3) toward the reference member (2) side.

What is claimed is:

1. (AMENDED)

A clamping apparatus, wherein

5 a central pillar (12) is projected from a reference member (2) so as to be inserted into a hole (5) opened in a movable member (3),

the central pillar (12) is provided with an inclined outer surface (13) that gets closer to the axis toward a leading end
10 of the projecting direction,

an annular intermediate member (15) in which at least a part of the circumferential direction is allowed to deform in both the expanding direction and contracting direction is arranged at the outside of the inclined outer surface (13), the
15 intermediate member (15) is provided with a straight outer surface (16) allowed to fit to an inner peripheral surface of the hole (5) and with an inclined inner surface (17) facing the inclined outer surface (13),

a pull member (21) is inserted into the central pillar (12)
20 axially movably, and the pull member (21) is connected to the intermediate member (15),

a lock means and a release means are provided in the reference member (2), the lock means moves the intermediate member (15) via the pull member (21) toward a base end for
25 locking and the release means moves the intermediate member (15) via the pull member (21) toward the leading end for releasing,

a fluid flow hole (38) is opened in the straight outer surface (16) of the intermediate member (15), and when the intermediate member (15) moves for locking and the straight outer surface (16) comes into close contact with the inner
5 peripheral surface of the hole (5), the fluid flow hole (38) is closed by the inner peripheral surface of the hole (5).

2. (AMENDED)

A clamping apparatus, wherein
10 a central pillar (12) is projected from a reference member (2) so as to be inserted into a hole (5) opened in a movable member (3), .

the central pillar (12) is provided with an inclined outer surface (13) that gets closer to the axis toward a leading end
15 of the projection direction,

a plurality of pressing members (43) that are radially movable are arranged at the outside of the inclined outer surface (13), and the pressing member (43) is provided with a straight outer surface (16) allowed to fit to an inner
20 peripheral surface of the hole (5) and with an inclined inner surface (17) facing the inclined outer surface (13),

a pull member (21) is inserted into the central pillar (12) axially movably, and the pull member (21) is connected to the pressing members (43),

25 a lock means and a release means are provided in the reference member (2), the lock means moves the pressing members

(43) via the pull member (21) toward a base end for locking, and the release means moves the pressing members (43) via the pull member (21) toward the leading end for releasing,

a fluid flow hole (38) is opened in the straight outer surface (16) of the pressing member (43), and when the pressing member (43) moves for locking and the straight outer surface (16) comes into close contact with the inner peripheral surface of the hole (5), the fluid flow hole (38) is closed by the inner peripheral surface of the hole (5).

10

3. (AMENDED)

A clamping apparatus, wherein

a central pillar (12) is projected from a reference member (2) so as to be inserted into a hole (5) opened in a movable member (3),

15

an inner sleeve (61) which is radially expandable and contractible is supported on the central pillar (12) movably along the axis of the central pillar (12), and a tapered outer surface (13) is formed on an outer peripheral surface of the inner sleeve (61),

20

an outer sleeve (71) which is radially expandable and contractible is arranged at the outside of the inner sleeve (61), a tapered inner surface (17) allowed to make a tapering engagement with the tapered outer surface (13) is formed on an inner peripheral surface of the outer sleeve (71), a straight surface (16) allowed to fit to an inner peripheral surface of

25

the hole (5) is formed on an outer peripheral surface of the outer sleeve (71),

an advancing means (25) which presses the inner sleeve (61) in such a direction as to tighten the tapering engagement is
5 provided,

a fluid flow hole (38) is opened in the straight outer surface (16), and when the straight outer surface (16) comes into close contact with the inner peripheral surface of the hole (5), the fluid flow hole (38) is closed by the inner peripheral
10 surface of the hole (5).

4. (AMENDED)

A clamping apparatus, wherein

a central pillar (12) is projected from a reference member
15 (2) so as to be inserted into a hole (5) opened in a movable member (3),

an intermediate member (15) which is radially expandable and contractible is supported on the central pillar (12) movably along the axis of the central pillar (12),

20 a tapered fitting surface (16) is formed on an outer peripheral surface of the intermediate member (15), a tapered inner surface (17) allowed to make a tapering engagement with the tapered fitting surface (16) is formed on the hole (5),

an advancing means (25) which presses the intermediate
25 member (15) in such a direction as to tighten the tapering engagement is provided, and

a fluid flow hole (38) is opened in the tapered fitting surface (16), and when the tapered fitting surface (16) comes into close contact with the tapered inner surface (17), the fluid flow hole (38) is closed by the tapered inner surface (17).

5

5. (AMENDED)

A clamping apparatus, wherein

a central pillar (12) is projected from a reference member (2) so as to be inserted into a hole (5) opened in a movable member (3),

10

an intermediate member (15) which is radially expandable and contractible is supported on a support hole (92) of the movable member (3) movably along the axis of the support hole (92),

15

a tapered inner surface (17) constituting the hole (5) is formed on an inner peripheral surface of the intermediate member (15), and a tapered fitting surface (16) allowed to make a tapering engagement with the tapered inner surface (17) is formed on the central pillar (12),

20

an advancing means (25) which presses the intermediate member (15) in such a direction as to tighten the tapering engagement is provided, and

25

a fluid flow hole (38) is opened in the tapered fitting surface (16), and when the tapered fitting surface (16) comes into close contact with the tapered inner surface (17), the fluid flow hole (38) is closed by the tapered inner surface (17).

6. (AMENDED)

A clamping apparatus as set forth in any one of claim 1 through claim 5, wherein

5 the fluid flow holes (38) are provided in plurality.

7. (AMENDED)

A clamping apparatus as set forth in claim 6, wherein

10 the fluid flow holes (38) are provided circumferentially in plurality.

8. (AMENDED)

A clamping apparatus as set forth in claim 1 or claim 2, wherein

15 a housing (9) provided in the reference member (2) is provided with a fluid port (39) for supplying pressurized fluid or discharging fluid,

a fluid passage (40) is provided inside the housing (9) and the fluid passage (40) is connected to the fluid port (39),

20 the fluid passage (40) is provided with a relay opening (41) in the inclined outer surface (13) of the central pillar (12), and

the fluid flow hole (38) is provided so that one end is opened in the straight outer surface (16) and the other end is
25 opened in the inclined inner surface (17) respectively, and the other end faces the relay opening (41).

9. (AMENDED)

A clamping apparatus as set forth in claim 8, wherein

the fluid flow holes (38) are provided circumferentially in

5 plurality,

the fluid passage (40) is communicatively connected to a groove (42) formed in the circumferential direction in at least either the inclined outer surface (13) of the central pillar (12) or the inclined inner surface (17) of the intermediate

10 member (15), and

each of the openings of the fluid flow holes (38) on the inclined inner surface (17) side faces the groove (42).

10. (AMENDED)

15 A clamping apparatus as set forth in claim 3, wherein

a housing (9) provided in the reference member (2) is provided with a fluid port (39) for supplying pressurized fluid or discharging fluid,

a fluid passage (40) is provided inside the housing (9),
20 and the fluid passage (40) is connected to the fluid port (39),

the fluid passage (40) is provided with a relay opening (41) in an outer peripheral surface of the central pillar (12),
and

the fluid flow hole (38) is provided so that one end is
25 opened in the straight outer surface (16) and the other end is opened in the tapered inner surface (17) respectively, and the

other end is connected to the relay opening (41) via a communication hole (79) formed in the inner sleeve (61) in a penetrating manner.

5 11. (AMENDED)

A clamping apparatus as set forth in claim 10, wherein the fluid flow holes (38) are provided circumferentially in plurality,

the fluid passage (40) is communicatively connected to a
10 groove formed in the circumferential direction in at least either the inclined outer surface (13) of the inner sleeve (61) or the inclined inner surface (17) of the outer sleeve (71), and each of the openings of the fluid flow holes (38) on the inclined inner surface (17) side faces the groove.

15

12. (AMENDED)

A clamping apparatus as set forth in claim 4, wherein a housing (9) provided in the reference member (2) is provided with a fluid port (39) for supplying pressurized fluid
20 or discharging fluid,

a fluid passage (40) is provided inside the housing (9), and the fluid passage (40) is connected to the fluid port (39),

the fluid passage (40) is provided with a relay opening (41) in an outer peripheral surface of the central pillar (12),

25 the fluid flow hole (38) is provided so that one end is opened in the tapered fitting surface (16) and the other end is

opened in an inner peripheral surface of the intermediate member (15) respectively, and the other end faces the relay opening (41).

5 13. (AMENDED)

A clamping apparatus as set forth in claim 12, wherein the fluid flow holes (38) are provided circumferentially in plurality,

the fluid passage (40) is communicatively connected to a
10 groove formed in the circumferential direction in at least either the inner peripheral surface of the intermediate member (15) or the outer peripheral surface of the central pillar (12), and

each of the openings of the fluid flow hole (38) on the
15 inner peripheral surface side of the intermediate member (15) faces the groove.

14. (DELETED)

15. (DELETED)

20 16. (DELETED)

17. (DELETED)

18. (DELETED)

19. (DELETED)

20. (DELETED)

25 21. (DELETED)

22. (DELETED)

23. (DELETED)

24. (DELETED)

25. (DELETED)

26. (DELETED)

5 27. (DELETED)

28. (DELETED)

29. (DELETED)

30. (DELETED)

31. (DELETED)

10 32. (DELETED)

33. (DELETED)

34. (DELETED)

35. (DELETED)